IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Ronald A. Askeland et al.	Examiner:	Lam S. Nguyen
Serial No.:	10/066,529	Group Art Unit:	2853
Filed:	January 31, 2002	Docket No.:	100201207-1
Title:	ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE		

CERTIFICATE OF TRANSMISSION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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1. Transmittal Letter for Appeal Brief (1 pg.); and
2. Appeal Brief under 37 C.F.R. (19 pgs)

Respectfully submitted,

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PATENT APPLICATION

ATTORNEY DOCKET NO. 100201207-1

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Ronald A. Askeland et al.

Confirmation No.: 3681

Application No.: 10/066,529

Examiner: Lam S. Nguyen

Filing Date: January 31, 2002

Group Art Unit: 2853

Title: ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE

Mail Stop Appeal Brief-Patents
Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on March 3, 2006.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $500.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

☐ (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d)) for the total number of months checked below:

☐ 1st Month $120	☐ 2nd Month $450	☐ 3rd Month $1020	☐ 4th Month $1590

☐ The extension fee has already been filed in this application.

☒ (b) Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account 08-2025 the sum of $ 500. At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees. A duplicate copy of this sheet is enclosed.

☐ I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450
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Rev 10/05 (ApBrief)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant:	Ronald A. Askeland et al.	Examiner:	Lam S. Nguyen
Serial No.:	10/066,529	Group Art Unit:	2853
Filed:	January 31, 2002	Docket No.:	100201207-1
Title:	ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE		

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This Appeal Brief is submitted in support of the Notice of Appeal filed March 3, 2006, appealing the rejection of claims 3-11, 21, 22, 24, 25, 27, 28, and 30-32 of the above-identified application as set forth in the Final Office Action mailed January 30, 2006.

The U.S. Patent and Trademark Office is hereby authorized to charge **Deposit Account No. 08-2025** in the amount of **$500.00** for filing a Brief in Support of an Appeal as set forth under 37 C.F.R. § 41.20(b)(2). At any time during the pendency of this application, please charge any required fees or credit any overpayment to Deposit Account No. 08-2025.

Appellant respectfully requests consideration and reversal of the Examiner's rejection of pending claims 3-11, 21, 22, 24, 25, 27, 28, and 30-32.

Appeal Brief to the Board of Patent Appeals and Interferences
of the United States Patent and Trademark Office
Appellant: Ronald A. Askeland et al.
Serial No.: 10/066,529
Filed: January 31, 2002
Docket No.: 100201207-1
Title: ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE

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Appeal Brief to the Board of Patent Appeals and Interferences
of the United States Patent and Trademark Office
Appellant: Ronald A. Askeland et al.
Serial No.: 10/066,529
Filed: January 31, 2002
Docket No.: 100201207-1
Title: ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE

REAL PARTY IN INTEREST

The real party in interest is Hewlett-Packard Development Company, LP having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

RELATED APPEALS AND INTERFERENCES

Appellant submits that there are no related appeals or interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal.

STATUS OF CLAIMS

Claims 3-11, 21, 22, 24, 25, 27, 28, and 30-32 are pending in the application (see Claims Appendix), and are the subject of the present Appeal.

Claims 3, 24, 27, and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by Smith et al. U.S. Patent No. 4,791,435.

Claims 4-11, 21-22, 25, 28, 30, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith et al. U.S. Patent No. 4,791,435 in view of Prakash et al. U.S. Patent No. 6,302,507.

STATUS OF AMENDMENTS

No amendments have been entered subsequent to the Final Office Action mailed January 30, 2006. The claims listed in the Claims Appendix, therefore, reflect the claims as of January 30, 2006.

SUMMARY OF THE CLAIMED SUBJECT MATTER

One aspect of the present invention, as claimed in independent claim 24, provides a printhead temperature control system. The system includes a printhead assembly (116) having a plurality of ejection elements (142); a temperature sensor (140) configured to generate a measured temperature of the printhead assembly; a memory device (122)

configured to store a thermal response model of the printhead assembly and an ejection history of the ejection elements; and a controller (110) configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements. The ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and the thermal response model of the printhead assembly includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired (see, e.g., Specification at p. 5, line 24 - p. 8, line 12; p. 15, line 2 - p. 16, line 25; and Fig. 1).

One aspect of the present invention, as claimed in independent claim 27, provides a method of controlling a temperature of a printhead (116) having a plurality of ejection elements (142). The method includes sensing a current printhead operating temperature with a sensor (140) on the printhead; and estimating an actual printhead operating temperature based on a thermal response model of the printhead, an ejection history of the ejection elements, and the current printhead operating temperature. The ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired (see, e.g., Specification at p. 5, line 24 - p. 8, line 12; p. 15, line 2 - p. 16, line 25; p. 16, line 26 - p. 17, line 20; and Figs. 1 and 6).

One aspect of the present invention, as claimed in independent claim 30, provides a method of controlling a temperature of a printhead (116) having a plurality of ejection elements (142) energizable by an electrical pulse having an amplitude and a pulse width. The method includes obtaining current operating parameters of the printhead and a current operating temperature of the printhead; determining an estimated actual operating temperature of the printhead based on a thermal response model of the printhead, the current operating temperature of the printhead, and the current operating parameters of the printhead, including an ejection history of the ejection elements; calculating an adjusted pulse width

based on pulse width calibration data for the printhead, the current operating parameters of the printhead, and the estimated actual operating temperature of the printhead; and applying the adjusted pulse width to the printhead to control printhead temperature. The ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired (see, e.g., Specification at p. 5, line 24 - p. 8, line 12; p. 15, line 2 - p. 16, line 25; p. 16, line 26 - p. 17, line 20; and Figs. 1 and 6).

One aspect of the present invention, as claimed in independent claim 31, provides a printhead temperature control system. The system includes a printhead assembly (116) having a plurality of ejection elements (142); a temperature sensor (140) configured to generate a measured temperature of the printhead assembly; a memory device (122) configured to store a thermal response model of the printhead assembly and an ejection history of the ejection elements; and a controller (110) configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements. The thermal response model includes a first set of parameters when the printhead assembly has been printing and a second set of parameters when the printhead assembly has not been printing (see, e.g., Specification at p. 5, line 24 - p. 8, line 12; p. 15, line 2 - p. 16, line 25; and Fig. 1).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellant seeks review of the rejection of claims 3, 24, 27, and 31 under 35 U.S.C. 102(b) as being anticipated by Smith et al. U.S. Patent No. 4,791,435.

Appellant seeks review of the rejection of claims 4-11, 21-22, 25, 28, 30, and 32 under 35 U.S.C. 103(a) as being unpatentable over Smith et al. U.S. Patent No. 4,791,435 in view of Prakash et al. U.S. Patent No. 6,302,507.

ARGUMENT

I. Rejection Under 35 U.S.C. §102

A. Applicable Law

To anticipate a claim under 35 U.S.C. 102, a reference must teach every element of the claim. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) ("A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference").

B. Rejection of claims 3, 24, 27, and 31 under 35 U.S.C. §102(b)

Because the Smith et al. U.S. Patent No. 4,791,435 fails to teach each and every element of the claims, the rejection of claims 3, 24, 27, and 31 under 35 U.S.C. 102(b) is not correct and should be withdrawn.

Independent claim 24 includes "a controller configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements," **wherein** "the thermal response model of the printhead assembly includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired."

Independent claim 27 includes "estimating an actual printhead operating temperature based on a thermal response model of the printhead, an ejection history of the ejection elements, and the current printhead operating temperature," **wherein** "the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired."

Independent claim 31 includes "a controller configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements," **wherein** "the thermal response model includes a first set of parameters when the printhead assembly has been printing and a second set of parameters when the printhead assembly has not been printing."

Independent claims 24, 27, and 31, therefore, each estimate an actual temperature of the printhead assembly based on (1) a measured or current operating temperature of the printhead assembly, (2) a thermal response model of the printhead assembly, and (3) an ejection history of the ejection elements, wherein the thermal response model includes (a) a first set of parameters when the ejection elements have been fired (i.e., the printhead assembly has been printing) and (b) a second set of parameters when the ejection elements have not been fired (i.e., the printhead assembly has not been printing).

The Smith et al. patent is directed to arrangements for controlling the uniformity of ink drops in inkjet printers by providing a control of the temperature of the printhead or pen (col. 1, lines 6-11), wherein thermal models of the pens or printheads are provided and used in conjunction with printhead temperature sensors to provide information useful in controlling printhead temperature, and wherein profiles of the use of each nozzle when compared with a thermal model provide information useful in controlling printhead temperature (col. 1, line 64 - col. 2, line 2). More specifically, the Smith et al. patent provides temperature compensation and control for both low printhead temperature and high printhead temperature (col. 2, lines 3-5).

To control the printhead temperature, the Smith et al. patent discloses estimating the printhead temperature based on temperature sensors (col. 4, lines 38-42). As such, the Smith et al. patent discloses that the indication of printhead temperature (viz., from temperature sensor TS) is employed in a decision making process to determine the temperature condition of the nozzles (i.e., whether the nozzles are cold or whether the nozzles are overheating) and is used with processor based information as to the location of the nozzles on the substrate, the color of the ink in a particular printhead, and the use profile of that printhead to maintain uniformity in the ink drops which are fired (col. 4, lines 53-63).

The use profile of the Smith et al. patent, therefore, is used to control printhead temperature and maintain uniformity in the ink drops, not estimate the printhead temperature. In one example, the Smith et al. patent discloses that in a single printhead arrangement, excessive temperature alone or rising temperature with "a high use profile" may be processed by the data processing section of the microprocessor to "produce a control to reduce data throughput to prevent the rise in temperature" (col. 5, lines 21-26). In another example, the

Smith et al. patent discloses that if the printhead exists in a low temperature situation unacceptable for printing and "the use profile is such that no viscous ink plugs exist in the nozzle," warm up pulses for the printhead (i.e., printhead control) may be selected (col. 5, line 67 - col. 6, line 3).

The Smith et al. patent, however, does not disclose estimating an actual temperature of the printhead assembly based on (1) a measured or current operating temperature of the printhead assembly, (2) a thermal response model of the printhead assembly, and (3) an ejection history of the ejection elements, wherein the thermal response model includes (a) a first set of parameters when the ejection elements have been fired (i.e., the printhead assembly has been printing) and (b) a second set of parameters when the ejection elements have not been fired (i.e., the printhead assembly has not been printing). Rather, as outlined above, the Smith et al. patent merely provides temperature compensation and control for different printhead temperatures, and only discloses temperature sensors for use in estimating the printhead temperature.

For at least the reasons set forth above, Appellant submits that the Smith et al. patent does not teach or suggest each and every element of independent claims 24, 27, and 31. Accordingly, Appellant submits that independent claims 24, 27, and 31 are each patentably distinct from the Smith et al. patent. Furthermore, as dependent claims 3-11 and 25 further define patentably distinct claim 24, dependent claim 28 further defines patentably distinct claim 27, and dependent claim 32 further defines patentably distinct claim 31, Appellant submits that these dependent claims are also patentably distinct from the Smith et al. patent. Appellant, therefore, respectfully submits that the rejection of claims 3, 24, 27, and 31 under 35 U.S.C. 102(b) is not correct and should be withdrawn, and that claims 3-11, 24, 25, 27, 28, 31, and 32 should be allowed.

II. Rejection Under 35 U.S.C. §103

A. Applicable Law

Under 35 U.S.C. §103, the Examiner has the burden to establish a *prima facie* case of obviousness. *In re Fine,* 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Three criteria must be satisfied to establish a *prima facie* case of obviousness. First, the

Examiner must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would teach, suggest, or motivate one to modify a reference or to combine the teachings of multiple references. *Id.* Second, the prior art can be modified or combined only so long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Third, the prior art reference or combined prior art references must teach or suggest all of the claim limitations. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). These three criteria are also set forth in M.P.E.P §706.02(j). Even when obviousness is based on a single reference, there must be a showing of suggestion or motivation to modify the teachings of that reference. *In re Kotzab*, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). In performing the obviousness inquiry under 35 U.S.C. §103, the Examiner must avoid hindsight. *In re Bond*, 910 F.2d 831, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990), *reh'g denied*, 1990 U.S. App. LEXIS 19971 (Fed. Cir. 1990).

B. Rejection of claims 4-11, 21-22, 25, 28, 30, and 32 under 35 U.S.C. §103(a)

Because the rejection of claims 4-11, 21-22, 25, 28, 30, and 32 under 35 U.S.C. 103(a) as being unpatentable over Smith et al. U.S. Patent No. 4,791,435 in view of Prakash et al. U.S. Patent No. 6,302,507 fails to establish a *prima facie* case of obviousness, the rejection of claims 4-11, 21-22, 25, 28, 30, and 32 is not correct and should be withdrawn.

Independent claim 30 includes "determining an estimated actual operating temperature of the printhead based on a thermal response model of the printhead, the current operating temperature of the printhead, and the current operating parameters of the printhead, including an ejection history of the ejection elements," **wherein** "the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired."

The Examiner contends that the Smith et al. patent discloses the claimed invention and calculating an adjusted pulse width based on the current operating parameters of the printhead and the estimated actual operating temperature of the printhead (Final Office Action, p. 4), and recognizes that the Smith et al. patent does not disclose wherein the calculation of the adjusted pulse width is based on pulse width calibration data or based on an optimal operating temperature, does not disclose wherein the pulse width calibration data is

in the form of an equation or in a look-up table, does not disclose wherein the controller reads the pulse width and pulse width calibration data from a memory located on the printhead assembly or a printer associated with the printhead assembly, does not disclose wherein the temperature sensor is an analog or digital temperature sensor and further including an analog to digital converter for generating a digital format from the analog temperature sensor, and does not disclose wherein the temperature sensor includes multiple temperate sensors distributed around the printhead assembly (Final Office Action, p. 4).

Accordingly, the Examiner contends that the Prakash et al. patent discloses a temperature control system for an ink jet printhead assembly having ink ejection elements energizable by an electrical pulse having an amplitude and pulse width, wherein the temperature control system includes a controller that calculates an adjusted pulse width based on pulse width calibration data or based on an optimal operating temperature, wherein the pulse width calibration data is in the form of an equation or in a look-up table, wherein the controller reads the pulse width and pulse width calibration data from a memory located on the printhead assembly or a printer associated with the printhead assembly, wherein the temperature sensor is an analog or digital temperature sensor and further including an analog to digital converter for generating a digital format from the analog temperature sensor, and wherein the temperature sensor includes multiple temperature sensors distributed around the printhead assembly (Final Office Action, pp. 4-5).

As such, the Examiner suggests that it would have been obvious for one having ordinary skill in the art at the time the invention was made to modify the calculation of energy of driving pulse disclosed by Smith et al. to be based on pulse width calibration data as disclosed by Prakash et al. (Final Office Action, p. 5).

As outlined above, Appellant submits that the Smith et al. patent does not disclose estimating an actual temperature of the printhead assembly based on (1) a measured or current operating temperature of the printhead assembly, (2) a thermal response model of the printhead assembly, and (3) an ejection history of the ejection elements, wherein the thermal response model includes (a) a first set of parameters when the ejection elements have been fired (i.e., the printhead assembly has been printing) and (b) a second set of parameters when the ejection elements have not been fired (i.e., the printhead assembly has not been printing).

Rather, as outlined above, the Smith et al. patent merely provides temperature compensation and control for different printhead temperatures, and only discloses temperature sensors for use in estimating the printhead temperature.

Accordingly, Appellant submits that modifying the Smith et al. patent in view of the Prakash et al. patent, in the manner suggested by the Examiner, does not teach or suggest all of the limitations of the present claims. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

In view of the above, Appellant submits that the Examiner has not established a *prima facie* case of obviousness of independent claim 30, and that independent claim 30 is patentably distinct from the Smith et al. and Prakash et al. patents. As dependent claims 21-22 further define patentably distinct claim 30, Appellant submits that dependent claims 21-22 are also patentably distinct from the Smith et al. and Prakash et al. patents. Appellant, therefore, respectfully submits that the rejection of claims 21-22 and 30 under 35 U.S.C. §103(a) is not correct and should be withdrawn, and that claims 21-22 and 30 should be allowed.

As outlined above, Appellant submits that the Smith et al. patent does not teach or suggest each and every element of independent claims 24, 27, and 31. As dependent claims 4-11 and 25 further define patentably distinct claim 24, dependent claim 28 further defines patentably distinct claim 27, and dependent claim 32 further defines patentably distinct claim 31, Appellant submits that dependent claims 4-11, 25, 28, and 32 are also patentably distinct from the Smith et al. and Prakash et al. patents. Appellant, therefore, respectfully submits that the rejection of claims 4-11, 25, 28, and 32 under 35 U.S.C. §103(a) is not correct and should be withdrawn, and that claims 4-11, 25, 28, and 32 should be allowed.

CONCLUSION

For the above reasons, Appellant respectfully submits that the art of record neither anticipates nor renders obvious the claimed invention. Thus, the claimed invention does patentably distinguish over the art of record. Appellant, therefore, respectfully submits that the above rejections are not correct and should be withdrawn, and respectfully requests that the Examiner be reversed and that all pending claims be allowed.

Any inquiry regarding this Appeal Brief should be directed to either James R. McDaniel at Telephone No. (858) 655-4157, Facsimile No. (858) 655-5859 or Scott A. Lund at Telephone No. (612) 573-2006, Facsimile No. (612) 573-2005. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,

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SAL:hsf

Scott A. Lund
Reg. No. 41,166

CERTIFICATE UNDER 37 C.F.R. 1.8: The undersigned hereby certifies that this paper or papers, as described herein, are being facsimile transmitted to the United States Patent and Trademark Office, Fax No. (571) 273-8300 on this 11th day of April, 2006.

By
Name: Scott A. Lund

CLAIMS APPENDIX

1-2. (Cancelled)

3. (Previously Presented) The temperature control system of claim 24 wherein the controller is located on at least one of the printhead assembly and a printer associated with the printhead assembly.

4. (Previously Presented) The temperature control system of claim 25 wherein the controller reads the pulse width and pulse width calibration data from a memory located on the printhead assembly.

5. (Previously Presented) The temperature control system of claim 25 wherein the controller reads the pulse width and pulse width calibration data from a memory located on a printer associated with the printhead assembly.

6. (Previously Presented) The temperature control system of claim 24 wherein the temperature sensor is an analog temperature sensor.

7. (Previously Presented) The temperature control system of claim 6 further including an analog to digital converter for generating a digital format from the analog temperature sensor.

8. (Previously Presented) The temperature control system of claim 24 wherein the temperature sensor is a digital temperature sensor.

9. (Previously Presented) The temperature control system of claim 24 wherein the temperature sensor includes multiple temperature sensors distributed around the printhead assembly.

10. (Previously Presented) The temperature control system of claim 4 wherein the pulse width calibration data is in the form of an equation.

11. (Previously Presented) The temperature control system of claim 4 wherein the pulse width calibration data is in a look-up table.

12-20. (Cancelled)

21. (Previously Presented) The method of controlling the temperature of claim 30 wherein the pulse width calibration data is in the form of an equation.

22. (Previously Presented) The method of controlling the temperature of claim 30 wherein the pulse width calibration data is in a look-up table.

23. (Cancelled)

24. (Previously Presented) A printhead temperature control system, comprising:

a printhead assembly having a plurality of ejection elements;

a temperature sensor configured to generate a measured temperature of the printhead assembly;

a memory device configured to store a thermal response model of the printhead assembly and an ejection history of the ejection elements; and

a controller configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements,

wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and wherein the thermal response model of the printhead assembly includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.

25. (Previously Presented) The temperature control system of claim 24 wherein the ejection elements are energizable by an electrical pulse having an amplitude and a pulse width, wherein the memory device is configured to store an optimal operating temperature of the printhead assembly, and wherein the controller is configured to adjust the pulse width based on the optimal operating temperature of the printhead assembly and the estimate of the actual temperature of the printhead assembly.

26. (Cancelled)

27. (Previously Presented) A method of controlling a temperature of a printhead having a plurality of ejection elements, the method comprising:

sensing a current printhead operating temperature with a sensor on the printhead; and

estimating an actual printhead operating temperature based on a thermal response model of the printhead, an ejection history of the ejection elements, and the current printhead operating temperature,

wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and wherein the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.

28. (Previously Presented) The method of claim 27 further comprising:

energizing the ejection elements with an electrical pulse having an amplitude and a pulse width; and

adjusting the pulse width based on an optimal operating temperature of the printhead and the estimate of the actual printhead operating temperature.

29. (Cancelled)

30. (Previously Presented) A method of controlling a temperature of a printhead having a plurality of ejection elements energizable by an electrical pulse having an amplitude and a pulse width, the method comprising:

obtaining current operating parameters of the printhead and a current operating temperature of the printhead;

determining an estimated actual operating temperature of the printhead based on a thermal response model of the printhead, the current operating temperature of the printhead, and the current operating parameters of the printhead, including an ejection history of the ejection elements;

calculating an adjusted pulse width based on pulse width calibration data for the printhead, the current operating parameters of the printhead, and the estimated actual operating temperature of the printhead; and

applying the adjusted pulse width to the printhead to control printhead temperature,

wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired, and wherein the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.

31. (Previously Presented) A printhead temperature control system, comprising:

a printhead assembly having a plurality of ejection elements;

a temperature sensor configured to generate a measured temperature of the printhead assembly;

a memory device configured to store a thermal response model of the printhead assembly and an ejection history of the ejection elements; and

a controller configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements,

wherein the thermal response model includes a first set of parameters when the printhead assembly has been printing and a second set of parameters when the printhead assembly has not been printing.

32. (Previously Presented) The temperature control system of claim 31 wherein the ejection elements are energizable by an electrical pulse having an amplitude and a pulse width, wherein the memory device is configured to store an optimal operating temperature of the printhead assembly, and wherein the controller is configured to adjust the pulse width based on the optimal operating temperature of the printhead assembly and the estimate of the actual temperature of the printhead assembly.

Appeal Brief to the Board of Patent Appeals and Interferences
of the United States Patent and Trademark Office
Appellant: Ronald A. Askeland et al.
Serial No.: 10/066,529
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Title: ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE

EVIDENCE APPENDIX

None.

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RELATED PROCEEDINGS APPENDIX

None.